A Study on the Proper and Effective Methods of Academic and Career/Technical Curriculum Integration

A Study for the General Assembly of Tennessee
(Public Chapter No. 354; HB 1225, SB 1385)

Presented by the
Tennessee Council on Career and Technical Education

TCCTE

Proper and Effective Methods of Integrating
Academic and Career/Technical Curriculum

Executive Summary

Policymakers and business leaders are increasingly emphasizing the role of occupational education in the state and country's economic development. Investments in developing a highly skilled workforce through occupational education can result in higher income levels and greater job opportunities, while reducing dependence on welfare and other assistance programs.

Career and Technical Education (CTE) has been on a path of incorporating rigorous and challenging academic content standards. CTE reinforces the rigor by providing students with non-duplicative sequences of courses leading to industry-recognized credentials or certificates, or associate or baccalaureate degrees (Office of Vocational and Adult Education, 2006).

The Tennessee General Assembly has requested that the Tennessee Council on Career and Technical Education conduct a study to address these needs to determine proper methods to integrate innovative and engaging academic curriculum initiatives in course offerings in the area of career and technical education. In Tennessee, data show of the 296,646 high school students, 175,186 enroll in at least one CTE program. There were 17,759 CTE majors in Tennessee high schools in the 2006/2007 school year. Comparing graduation rates of the previous school year (latest confirmed data), students who major in a CTE program graduate at a rate of 91.51% compared to the state average which is a graduation rate of 80.7%.

Additionally, for the 2005/2006 school year, the Tennessee Board of Regents reports an 88.8% completion rate at the Tennessee Technology Centers as compared to a 25% completion rate in Community Colleges and Universities reported on 2004 graduates by the Tennessee Higher Education Commission. These data are based on freshmen enrolled for the first time.

Rapidly changing advancements in technology and increased global competition have resulted in a strong need for students in our state to have the educational foundation that will prepare them to compete in manufacturing and other sectors identified by economic and workforce development studies.

According to Bailey and Matsuzuka (2003) in a study on integration of career/technical and academic curricula, there are two main types of curriculum integration. One is content integration, and the other is process integration. This study focuses on process integration.

The Tennessee Department of Education, Division of Career and Technical Education, provided grants to nine high schools throughout Tennessee with the charge of developing or initiating models of integration. This project was titled “Career Academic Technical Integration” (CATI). The CATI projects were centered on process integration. A review of the data and information reported by schools participating in the CATI projects revealed five common elements (or conditions) requisite to the success of any program. These held true regardless of whether the school was rural, urban, large or small, or economically advantaged or disadvantaged. The elements are:

Recognition of a common need which benefits students

The common need must be data based to avoid hearsay. Data is the justification that the need is real. The need must then be connected to at least one educational objective cited in the school’s annual improvement plan.

Administrative support

Without administrative support, the need is not seen as important. Teacher concerns are not addressed in an adequate manner which in turn causes doubt and weak support from faculty members.

Faculty buy-in/ownership

If the objective for integration is a need to increase student achievement, then teachers are less likely to view integrated teaching as merely another mandated burden diverting them from their primary mission. Integration offers teachers an important tool for raising the achievement of underperforming students.

On-going and in-depth professional development

Integration requires a great deal of time in the training of teachers. To acquire an understanding and mastery of issues, such as time, resources, guidance, and materials development, necessitates an extensive planning process. It involves studies of pedagogy in hands-on problem-solving, cooperative and team-based projects, multiple forms of expression, and project work that draws on knowledge and skills from several domains.

Periodic evaluation to enhance the continuous improvement process and curriculum development

Moen (1989) identifies a method for continuous improvement regarding process integration. He suggests that systemic changes must occur within the organization for continuous improvement to be successful and reoccurring.

With the above general conditions that must be present to successfully integrate academic and career/technical curricula, there are six general integration models that have been identified to be successful. The following models are presented by the Center on Education and Training for Employment in “Implement an Integrated Academic and Vocational Education Curriculum” (Norton et al, 1998). They are:

1. **Discipline-Based Curriculum Integration**:

   Teachers relate cross-curricular ideas while teaching their own disciplines.

2. **Parallel Curriculum Integration**:
   Teachers in their different classes teach independently but plan to have lessons coincide so that they simultaneously cover the same themes, issues, topics, or concepts.

3. **Multi-disciplinary Curriculum Integration:**
   Teachers from several subjects bring together two or three disciplines to teach common themes, issues, topics, or concepts.

4. **Inter-disciplinary Curriculum Integration:**
   Teachers coordinate a single unit that connects all of the disciplines (e.g., our changing world). A large block of time is necessary here. This is a more complex model of integration that includes *all* students' subjects.

5. **Integrated Day Curriculum Integration:**
   Teachers base lessons or curriculum units on student-identified themes, issues, topics, or concepts to be viewed across the curriculum (e.g., time travel).

6. **Field-Based Curriculum Integration:**
   Teachers expand the boundaries of the classroom, creating opportunities for students to learn or practice skills and knowledge in the field or at the worksite.

The study in its entirety follows this executive summary. This study on proper and effective methods of integration of academic and career/technical curriculum is respectfully submitted by the Tennessee Council on Career and Technical Education to the General Assembly of the State of Tennessee as assigned through Public Chapter no. 354; House Bill no. 1225; Senate Bill no. 1385.

Proper and Effective Methods of Integrating Academic and Career/Technical Curriculum

A Study Completed by the Tennessee Council on Career and Technical Education

Career and technical education is a massive enterprise in the U.S. Thousands of comprehensive high schools, vocational and technical high schools, area vocational centers, and community colleges offer career and technical education programs. Virtually every high school student takes at least one career and technical education course, and one in four students take three or more courses in a single program area. One-third of college students are involved in career and technical programs, and as many as 40 million adults engage in short-term postsecondary occupational training.

Eighty-five years after the passage of the first piece of federal vocational education legislation, career and technical education is evolving from its original and sole focus on preparing students for work immediately following high school. Today's career and technical education program increasingly incorporates rigorous and challenging academic content standards and provides a non-duplicative sequence of courses leading to an industry-recognized credential or certificate or an associate or baccalaureate degree (Office of Vocational and Adult Education, 2006).

In Tennessee, data show similar results. Of the 296,646 high school students, 175,186 enroll in at least one CTE program. There were 17,759 CTE majors in Tennessee high schools in the 2006/2007 school year. Comparing graduation rates of the previous school year (latest confirmed data), students who major in a CTE program graduate at a rate of 91.51% compared to the state average which is a graduation rate of 80.7%. Additionally, for the 2005/2006 school year, the Tennessee Board of Regents reports an 88.8% completion rate at the Tennessee Technology Centers as compared to a 25% completion rate in Community Colleges and Universities reported on 2004 graduates by the Tennessee Higher Education Commission. These data are based on freshmen enrolled for the first time.

Rapidly changing advancements in technology and increased global competition have resulted in a strong need for students in our state to have the educational foundation that will prepare them to compete in manufacturing and other sectors identified by economic and workforce development studies in this rapidly changing global workplace.

A second issue has been a preparedness of people in some other countries (for a variety of reasons) to fill occupations requiring a sophisticated technical expertise that incorporates math and science.

According to the Academy of Science in their publication, *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future* (2007), "the rise of new international competitors in science and engineering is forcing the United States to ask whether its education system can meet the demands of the 21st century" (p. 3). Senators Alexander and Bingaman, and Representatives Boehlert and Gordon requested the committee to respond to several pertinent questions and make recommendations as to what the United States must do to enhance the science and technology enterprise to compete in the global community. In a world where advanced knowledge is widespread and low-cost labor is readily available, U.S. advantages in the marketplace and in science and technology have begun to erode. A comprehensive and coordinated federal effort is urgently needed to bolster U.S. competitiveness and pre-eminence in these areas. This congressionally requested report makes four recommendations along with 20 implementation actions that federal policy-makers should make to create high-quality jobs and focus new science and technology efforts on meeting the nation's needs, especially in the area of clean, affordable energy. The four recommendations are:

1) Increase America's talent pool by vastly improving K-12 mathematics and science education;
2) Sustain and strengthen the nation's commitment to long-term basic research;
3) Develop, recruit, and retain top students, scientists, and engineers from both the U.S. and abroad; and
4) Ensure that the United States is the premier place in the world for innovation.

In Tennessee, we are fortunate to have some of the types of programs recommended by the Committee on Prospering in the Global Economy of the 21st Century in the report *Rising Above the Gathering Storm*. Not only do these programs address the need for Science, Technology, Engineering, and Mathematics (STEM) education, they serve as excellent examples of programs that integrate career and technical education subject matter with related academic subject matter.

For example, the report recommends teacher education and professional development in Science, Technology, Engineering, and Math (STEM) strategies. The report also recommends curricular materials that are available online, free of charge and as a voluntary national curriculum that would provide an effective high standard for K-12 teachers. As one example in Tennessee, Tennessee Technological University is developing professional development institutes for all teachers, including career and technical education teachers, with the purpose of understanding STEM concepts and strategies to include them in every day lessons.

One of the specific notable programs cited in the report is the Project Lead the Way (PLTW) program (when taught as a 4-year program with college preparatory math and science), which the report concluded did a better job of helping prepare students for college engineering programs than students prepared in more traditional curricula. The report says that the PLTW program introduces students to the scope, rigor, and discipline of engineering and engineering technology. Some of the Project Lead the Way programs are offered in Tennessee. Sites of note in Tennessee are: Cleveland High School, Lexington Middle School, Martin Luther King Magnet School, and Soddy-Daisy High School. There are presently twenty-eight existing PLTW sites in Tennessee. Other STEM based programs in Tennessee are listed in the Successful Curriculum Integration section in this report.

In an older study by Vaughn (1989), the impact that a strong occupational education has on economic development is observed. He states that an increase in investments in educating and training non-college bound students is essential to increasing economic growth. Additionally, he contends without this investment that unskilled people will be unable to secure anything but low-paying jobs being unqualified to obtain well-paying, high-skilled jobs. Vaughn states, "it is unrealistic to expect all new entrants [into the workforce] to prepare for their careers through academic rather than occupational training. For someone with a career in mind and little interest or aptitude for academic subjects, college is an inefficient way to learn about the world of work. College will always remain the choice of a small- although important – part of the workforce" (p. 59).

Vaughn's findings are consistent with the 2007 *Rising above the Gathering Storm* publication cited above. Both reports state that technological change and advancement do not eliminate jobs, but rather they redistribute them to industries demanding stronger basic skills. The expansion of the technological innovation, research and development in Asian countries demonstrates the need to strengthen the academic and career/technical curriculum. Industries will look globally for the best skilled workforce to meet their need(s).

Research has found that occupational education has lowered dropout rates, raised family incomes, and provided skills to those who would not otherwise obtain them. It offers not only technical skills, but an understanding of work that my help develop more positive attitudes. If education reform is to make a difference, then the full potential of an occupational education system must be developed.

The role of career and technical education traditionally has been skill preparation for students. With the introduction of "No Child Left Behind" and a change in emphasis in improving student performance in the traditional academic subjects of English, Math, and science, it has become critical for career and technical education to be an integral part of educational preparation as our state and nation work to prepare students for the challenging occupational needs for today and tomorrow. The central part of the curriculum integration concept is to combine the best curricular and pedagogical practices of academic and career and technical education into a single, integrated program that is available to all high school students. (Bodilly et al.,1994).

One form of education reform is modification of the educational structure that is being implemented in schools across the state to focus on collective rather than individual teacher and student teaching and learning. Teamwork contrasted with individual work, and group processes instead of isolated activity are being emphasized. This restructure is a part of the integration of career/technical and academic curriculum.

According to Bailey and Matsuzuka (2003) in a study on integration of career/technical and academic curricula, there are two main types of curriculum integration. One is content integration, and the other is process integration. This study focuses on process integration. It was found that the processes of implementation are critical in developing and implementing a successful integrated curriculum model. Without adherence to the process, success is not likely. Content integration will be mentioned briefly. "Whatever form integration takes, from a single short-term student project to an entire school organized around a major industry like health or transportation, it should begin by clearly specifying the educational goals. It is very easy to get caught up in the novelty and excitement of integrated learning and lose sight of the learning objectives. One way to avoid this trap, while still maintaining the fun and excitement, is to use academic and industry skill standards to direct integrated learning" (Bailey & Merrit, 1997; Rossi, Hoachlander, Mandel, Rahn, & Sanborn, 1998).

The Tennessee Department of Education, Division of Career and Technical Education, provided grants to nine high schools throughout Tennessee with the charge of developing or initiating models of integration. This project was titled "Career Academic Technical Integration" (CATI). The CATI projects were centered on process integration. Additionally, each CATI site included the project as part of a continuous improvement process that was closely connected to the identification of a common need. The identified common need became a part of the school's continuous improvement plan and as one need was solved, other needs arose. It was recognized that integration needs must address improved student achievement. The developed models were research based, implemented school wide, and then field tested within a three-year period. The models were to be replicable in any school. A review of the data and information reported by schools participating in the CATI projects revealed five common elements (or conditions) requisite to the success of any program. These held true regardless of whether the school was rural, urban, large or small, or economically advantaged or disadvantaged. The elements were:

1. **Recognition of a common need which benefits students**

   The common need must be data based to avoid hearsay. Data are the justification that the need is real. The need must then be connected to at least one educational objective cited in the school's annual improvement plan. If the objective is not in the plan, the plan should be amended to include it. "To be effective, an integration activity must accomplish an important, well-defined educational objective. Integration is not an end in itself, no matter how engaging the activity may be. Yet precisely because integrated curriculum emphasizes connections and context, it is often easy to lose focus and clear meaning." (Hoachlander, 1999). Bailey (1997) suggests there is only one clear objective in any school. He states that integration must be guided by one central purpose which is to increase student achievement.

To further illustrate the importance of the remedy addressing a need included in the school improvement plan, Moen (1989) states that consistency of purpose is a determining factor in successful teaching. “Administrators and teachers should start by developing a mission and take every opportunity to convey its meaning and emphasize its central and dominate role. Teachers and administrators must communicate the mission by relating the work of the different departments to this mission. The best form of communication is practicing and reinforcing the mission daily” (pg. 4).

2. Administrative support

The main purpose of the school administrator is concern with the principles, practices, and rationalized techniques employed in achieving the objectives or aims of an organization. Without the project being included in the aim or the objectives of the school improvement process, it will not succeed.

Every school team that participated in the CATI project identified administrative support as the major factor in success of the chosen project. Without administrative support the need is not seen as important. Teacher concerns are not addressed in an adequate manner which in turn causes doubt and weak support from faculty members. Further, the staff development activities and training are not taken seriously by staff members. Administrative support provides the vision and the continuous striving to achieve the vision.

Administrative support in helping teachers understand constraints assists in gaining teacher support for working within those constraints. Providing and maintaining adequate and open communication is one area where administrator support is crucial. Open communications with the teachers help administrators identify and resolve scheduling problems, and administrators must be innovative in this area. Scheduling has been noted as a major barrier to effective integration.

Finally, without administrative support, resources will not be forthcoming. A study done by NCRVE (1992) found that resources, such as time, funds, and allowing full participation in the project, must be evident or limited buy-in by the staff will result. “Critical to the success of integration efforts is for teachers to feel confident of administrative support” (p. 23). Failure to do so on an ongoing basis quickly leads to teacher resentment toward the changes. In successful integration initiatives, administrators were not only involved at initial stages of the process but throughout the implementation.

3. Faculty buy-in/ownership

If the objective for integration is a need to increase student achievement, then teachers are less likely to view integrated teaching as merely another mandated burden diverting them from their primary mission. Integration offers teachers an important tool for raising the achievement of underperforming students (Bailey, 1997). Faculty cooperation can be viewed in stages. In the first stage career/technical and academic teachers learn about each other and begin asking for help. The second stage advances from simply offering help to one another to teachers actually planning together. The third and final stage is where cooperative efforts among teachers produce consistent information being provided to students through rescheduling and restructuring of course instructional sequences to reinforce what students are learning in each class. (NCRVE, 1992)

4. On-going and in-depth professional development

Integration requires a great deal of time in the training of teachers. Acquiring an understanding and mastery of issues, such as time, resources, guidance, and materials development, necessitates an extensive planning process. It involves studies of pedagogy in hands-on, problem-solving, cooperative and team-based projects; multiple forms of expression; and project work that draws on knowledge and skills from several domains. Attempts at pedagogical change with a lack of far-reaching staff development are doomed to failure. Studies show that collaboration between academic and career/technical teachers takes several years to institutionalize. (Bodilly et al., 1994) .

Because most teachers have been trained to teach curricula that are school-based and subject-specific, professional development is necessary for teachers to adapt to different roles and teaching strategies. Stasz (1997) states that teachers need to increase their knowledge of workplace practice and authentic applications of their subjects, create high-quality integrated curricula that combine academic and career/technical skills, adopt teaching roles that support authentic learning, and develop alternative assessments that provide meaningful feedback. Time must be provided for teachers to plan lessons, visit businesses and other schools, and meet with the curriculum team (Paris, 1998).

5. Periodic evaluation to enhance the continuous improvement process and curriculum development

Moen (1989) identifies a method for continuous improvement regarding process integration. He suggests that systemic changes must occur within the organization for continuous improvement to be successful and reoccurring. The process depends on first understanding of needs; second, design of the process to meet the needs; third, knowledge of the present design of the existing education process. Next, knowledge of the psychology of learning [implying acceptance and inclusion of various pedagogies] should be gained, and, finally, the curriculum is redesigned to better match the identified needs (Moen, p. 11). Following are Moen's ten steps to a planning, implementation, and review process, which are consistent with the findings from the CATI study:

(1) Identify a need based on data (emphasis on evidence rather than speculation).
(2) Propose a remedy that is research based—a method that has been proven to be successful for that need.
(3) Establish a planning team that represents the school's professional population (principal, counselor, academic, career and technical, special education). The program also needs the full support of the superintendent, and the school board should be aware of the initiative. The first year should be devoted to planning. The school may decide to pilot part of the program during the first year, but the focus needs to be on planning and team building of the professional staff.

    Planning activities include the following:
    - Garner support among all groups in the school population.
    - Relate instructional programs in all academic, special education, and career/technical areas to the activity.

(4) Participate in relevant professional development.
(5) Set a timetable for benchmarks leading to total program implementation.
(6) Identify acceptable levels of success.
(7) Evaluate and revise where needed.
(8) Implement the program.
(9) Assess the program—formative and summative assessments. Determine a common mode of assessment and assess program effectiveness at pre-determined intervals and conclusion of a pre-determined time period.
(10) Develop a plan for determining next steps, based on needs, collecting data and evaluating results, and modifying or setting new target(s).

Stasz and Grubb (1991) and Pritz (1989), developed models consistent with the above outline elements of success. They are:

- Vision and commitment from all levels
- Consistent support form district administrators and state officials
- New resources, including funding
- Autonomy for teachers
- Evaluation of efforts
- Adequate time for implementation

With the above general conditions that must be present to successfully integrate academic and career/technical curricula, there are six general integration models that have been identified to be successful. The following models are presented by the Center on Education and Training for Employment in "Implement an Integrated Academic and Vocational Education Curriculum (Norton et al., 1998). Each CATI model's design was consistent with the following models which are:

1. Discipline-Based Curriculum Integration:

Teachers relate cross-curricular ideas while teaching their own disciplines. Teachers teach in traditional ways, but they show awareness of students' need to find a practical use for classroom knowledge. While this model involves a low level of integration, it is a way for teachers to begin making connections between their own subject content and other subject content. Grub, et al. (1991) identifies incorporating more academic content in vocational courses consistent with this model.

2. Parallel Curriculum Integration:

Teachers in their different classes teach independently but plan to have lessons coincide so that they simultaneously cover the same themes, issues, topics, or concepts. For example, the world history class is studying scientific discoveries, the science class is studying Galileo, the English class is studying biographies, the math class is studying parabolic curves, and the physics class is studying laws of motion simultaneously. This model requires coordination among two or more teachers. Grub, et al. (1991) recognizes combining vocational and academic teachers to enhance academic competencies in vocational programs which are reliable with this model. Hoachlander (1999) labels this model as "standards-based integration."

3. Multidisciplinary Curriculum Integration:

Teachers from several subjects bring together two or three disciplines to teach common themes, issues, topics, or concepts. Teachers help make the connections for students, who may not necessarily see them on their own. As an example, while learning to work on engines in the laboratory, automotive technology students may study combustion in physics class, write about the process of engine combustion in English class, and calculate rations in math class. Larger blocks of class time (i.e., classes following one another) enhance the implementation of this model. Grub, et al. (1991) equates this model with making academic courses more vocationally relevant. This model is also considered the academy model. Hochlander (1999) refers to this model as "course-level integration" with elements in his recognition of school-wide integration.

4. Interdisciplinary Curriculum Integration:

Teachers coordinate a single unit that connects all of the disciplines (e.g., our changing world). A large block of time is necessary here. This is a more complex model of integration that includes *all* students' subjects. Grub, et al. (1991) calls this model "curricular alignment" where both vocational and academic courses align and consider sequence of courses. This model is also considered the small learning community model. Hochlander (1999) identifies the term "cross-curriculum integration" for this model, which also includes elements of programmatic integration through career clusters and industry majors.

5. Integrated Day Curriculum Integration:

Teachers base lessons or curriculum units on student-identified themes, issues, topics, or concepts to be viewed across the curriculum (e.g., time travel). This model requires strong cooperation and planning.

6. Field Based Curriculum Integration:

Teachers expand the boundaries of the classroom, creating opportunities for students to learn or practice skills and knowledge in the field or at the worksite. This model has great possibilities in academic/CTE integration because it gives students a chance to work on a project that combines academic knowledge from several disciplines with CTE hands-on skills. The Southern Regional Education Board (SREB) considers this model to be based on occupational clusters or occupational majors.

Curriculum Integration within the Conext of School Reform

According to Mike Schmoker (1999) in his book, *Results: The Key to Continuous Improvement*, "School improvement is not a mystery. Incremental, even dramatic improvement is not only possible but probable under the right conditions." According to Mike Schmoker, a recurrent theme in research is "an emphasis on principles and practices that (1) are simple and supported by research, (2) are relatively few in number, and (3) have huge but under used potential" (p. 1). Summarizing additional literature, Schmoker notes that school reform often fails because goals are not targeted to student achievement and that the system favors symbols of progress rather than substantive progress.

School improvement, similar to the movement in business and industry, can occur within a context of continuous improvement. Once goals are set, needs are identified, and strategies established and implemented, schools can determine the effectiveness of their actions and refine or redirect them toward further student achievement. This report considers strategies related to the integration of career/technical and academic subject matter. Research shows that these strategies when used as a part of a continuous improvement process directed by a school can improve student performance.

These strategies when used as novelty programs will not have a long-term benefit but, when they are used as tools within a school's overall effort to raise student performance, they can have a significant impact. In a continuous improvement process, a school may determine a weakness in reading, math, or science. Integration strategies incorporated in this report can address the need of the school to raise performance in these areas. The results of their use in the program can be assessed and the program would be modified as needed on an ongoing basis as the school works to achieve its goals.

Not only may these strategies be successful tools for raising student achievement in reading or math, they also are excellent tools when incorporated with problem-solving strategies for raising thinking and performance to the higher levels needed by business and industry to meet the challenges posed by technology and competition in the global economy.

Curriculum content integration is another type of integration. The following are five characteristics of content integration:

1) Migrating content from one curriculum to another
2) Aligning part or all of the content between two or more academic and career/technical content areas
3) Obtaining or developing teaching aides and materials for all integraged content areas
4) Allowing teachers to teach one another on aligned content to be mastered
5) Providing staff development on a large scale and communicating information to other faculty members, students, and parents on the integration of subject areas

In Tennessee, each Career and Technical Education (CTE) curriculum area includes an academic standards cross-walk to the partcular CTE class standards. It is noted that the actual integration activities that are taking place throughout the state are not being formally documented, and little, if any, professional development has been provided on a state-wide basis. However, there are schools noted that utilize this type of integration.

Barriers to Effective Curriculum Integration

The reality is that for the strategies to be successful with sufficient depth to advance, student behavior to the high level required by the state and national economy, the issues and methods are much more complex.

In many places across the state, faculty have successfully integrated subject matter in the two areas. But structural and instructional habits call for a more systemic approach to the integration of subject matter.

For example, an individual traditional academic or career and technical teacher may want to incorporate content of the other area within a class. However, if either teacher does not have the expertise to identify or integrate such content, then the historic barriers between the faculty in these two divisions of the school may interfere with an opportunity for instructors teaching related subject matter to share content and ideas.

Maybe two instructors (science and health science) have discovered curriculum content common to both of their areas, but they do not find sufficient time in the school day to coordinate instruction. They may decide that they would prefer to have their classes or common students work on a joint activity but that their schedules do not fit together.

"As students move from class to class and progress to the next grade, they are exposed to isolated bits of content-specific knowledge, but they are not taught to transfer information learned in one class as it relates to another or its application in the world outside of school. Incorporating more rigorous and relevant instruction in classrooms is a realistic goal and will yield immediate results in students' enthusiasm to learn. When students are engaged in the learning process, real achievement takes place, and their chances to excel at what they do increase. Often, all that is required is a change of attitude and the willingness to restructure education so that it prepares students for life, not just the state test or for more school. Effectively integrating subjects is an important step …and it costs little."(Daggett, 2005)

Lack of time for planning and implementation is the most identified barrier in the CATI study. Time has also been identified as a barrier in many other studies by Schmidt et al. (1992), Faulkner et al. (1992), Bottoms and Daggett, among others.

To effectively integrate curriculum, time must be provided for teachers to be able to plan, study, and review pedagogy, strategies, and procedures. It is stated that one year of planning needs to take place prior to any integration initiative to be implemented successfully. Additionally, time must be provided for continuous evaluation and redesign.

Funding is an issue that makes its way to the list of barriers to effective integration implementation. New initiatives are often accompanied by grants to assist in getting an initiative off the ground. Frequently, grant funding is for a short period of time. During the funding period, the initiative works well and is regarded as a valuable project and use of time. However, studies show that once the funding is reduced or eliminated, the initiative is frequently dropped or severely limited. Interest wanes and the local system usually does not pick up the expense of continuing to operate the program at the maximum level.

Initiatives often seem to be associated with the name(s) of the implementer(s). A change in staff may be misinterpreted as a sign that a strategy is outdated.

Velde (2000) found that fostering a change in philosophy is not easy. Most teachers involved with curriculum integration say it is much more than a partnership between two or more subject areas, but involves a philosophy shift across the entire school. Most define that shift as one from teacher-dominated to child-centered learning, where teachers and students become life long learners and teachers use strategies to encourage children to solve problems through thinking, gathering information, analysis and synthesis. This barrier is closely related to two others: time and professional development. It is very difficult to change the way teachers teach. Many view integration as an added subject rather than a shift in the way the subject is being taught. Finch et al. (1992) states "as schools and schooling are evolving, professional development processes and content must likewise evolve to meet the challenging needs of education professionals" (p. 3).

Successful Curriuclum Integration in Tennessee

The Career Academic Technical Integration (CATI) Project:

The CATI initiative originally involved 23 high schools. The sites were given one year to develop a model of integration. The schools were required to demonstrate that the model either raised or had the potential to raise student achievement. Second, the models had to be data driven and research based. Finally, the models had to show potential to be replicable at other high schools. Of the initial 23, nine sites were chosen to continue into a second year. In the second year, each continuing site identified a "sister" school of similar demographics to field test the process. Each sister school demonstrated similar results in the third year of the project of the original nine sites.

By utilizing the parallel curriculum integration model, one county, an original site in the pilot, identified a school-wide weakness in reading. The need crossed all areas, encouraging the faculty's buy-in to the program. The program had strong administrative support, which was even further supported by leaders in the community. In the program all students and faculty read a designated book during the year. Professional development was provided, and each teacher was expected to develop lesson plans within his/her subject area which promoted the theme of the book. Additionally, a variety of school-wide activities were built around the book.

Data Results on Student Achievement in Reading Across the Curriculum:

ACT Scores		Dec. 2003	Dec. 2004	Increase
		19.97	21.68	1.71
Gateway		Spring 2004	Spring 2005	% Increase
	English	92%	97%	5%
	Algebra I	83%	96%	13%
	Biology	98%	100%	2%
EOC*		Spring 2004	Spring 2005	% Increase
	English 9	80%	88%	8%
	Foundations II	69%	96%	27%

* End of Course Test

The staff at the same school assessed the project with the following survey results:

Teacher Assessment of the Project
Percentage of Teacher Responses Labeled as Outstanding or Above Average
86% - Project aided in reading improvement
90% - More reading occurred
86% - Awareness of the importance of reading
96% - Participation of students in school-wide project
82% - Participation of teachers in school-wide project
95% - Overall planning of project
96% - Presentation of project
86% - Appropriateness of staff development

The program encountered some obstacles when some teachers had difficulty relating their subject matter to the selected book. They requested support from the principal and assistant principal who were able to help them overcome the hurdle by brainstorming with the teachers to identify connections between their subject matter and the book.

A neighboring county, which field tested the program to address similar student performance difficulties, did not experience the same benefits. Lack of administrative support and professional development were cited as reasons for difficulty with complete implementation.

Success with a small group of teachers and students will move to the entire school when administrators support the project. Other teachers want all students as well as themselves to experience the success. The following school also chose the parallel curriculum integration model.

A project that was very successful was one from a large rural high school that identified career and technical student's weak performance on the high school writing assessment. The planning team along with the principal decided to implement a project of writing across the curriculum with CTE students only. The CTE staff underwent extensive professional development. The main concern was fear that the project would be an "add-on" to an already full curriculum. Professional development included ways to change how instruction was delivered rather than what was being taught. The results were radical. One hundred percent of the CTE students passed the writing assessment in the first year of implementation. As a result of the dramatic outcome, the entire school has adopted the project, and the positive results have solved the need. The planning team cites the principal as the driving force behind the success of the program. Further, he addressed teacher concerns with determination and supported the in-depth staff development that occurred. When piloted in a neighboring school, the project was implemented school-wide, and the results were identical.

Another school-wide project was implemented in a rural unit school using the multidisciplinary curriculum integration model. The planning team included the principal; a commercial program was purchased. The common need was for all students to successfully pass the Gateway and End-of-Course examinations and increase the graduation rate. Further, the school determined to increase the number of students who passed the examinations at the advanced level. The following chart illustrates the results:

Gateway Exam	2002-2003	2003-2004	2004-2005
English II	100% passed 73% advanced	97% passed 80% advanced	*94% passed 72% advanced (*33% special ed)
Biology	100% passed 59% advanced	93% passed 61% advanced	100% passed 74% advanced
Algebra I	95% passed 59% advanced	95% passed 62% advanced	96% passed 85% advanced

End of Course			
English I	85% passed 40% advanced	*80% passed 34% advanced (*22% special ed)	90% passed 47% advanced
Foundations II	89% passed 65% advanced	100% passed 79% advanced	*95% passed 70% advanced (*40% special ed)
Graduation Rate	84%	87%	88%

The main problem cited by the school was the lack of gaining faculty "buy-in." Although the project succeeded, there was conflict within the faculty. The planning team cited lack of continuing administrative support and not addressing teacher concerns in a timely and effective manner.

When this project was piloted at a similar school with similar demographics, the same problem was cited. In the pilot, the planning team did not continually involve the principal in the decision making which resulted in staff/administration conflict. The project suffered and was almost eliminated. After long planning meetings, the situation was resolved and the project continued in a modified version, but the results persisted to show student improvement.

It was found that although the project was a commercial product, administrative support and in-depth professional development continued to be cited as the key elements to success of the project.

By using the multidisciplinary curriculum integration approach, a similar project was established in a small high school where four teachers (two academic and two CTE) decided to choose a thematic approach to address an identified need for 9th graders. Many students were having trouble passing the Algebra I Gateway examination on the first seating. A theme was chosen that would be popular with the students. Skills that were identified to be enhanced follow: Expanding and integrating knowledge skills, thinking and reasoning skills, and communication skills. The teachers used a collaborative approach to integrate the curriculum. The pre- and post-project Gateway scores were impressive.

	Proficient	Advanced
Pre-Project Gateway	78%	25%
Post-Project Gateway	98%	64%

Consequently, other faculty members began collaborating and integrating similar thematic instruction. The planning team cited the support of the principal in allowing classes to be combined and switched when needed and allowing the flexibility to plan together.

One school developed an occupational academy to address the identified need. To measure success, the TCAP predictor was compared to the students' actual performance on the Gateway exams. In every case, the students scored higher than was predicted and none of the sample group scored less than proficient.

A second school that developed a 9th grade academy received similar results. By using the same method of evaluation, the results for the students in that academy were reported as follows over three years:

Assessment	Predicted	Observed	
English I End of Course: Advanced	26%	57%	
English I End of Course: Proficient	92%	94%	
Algebra I: Advanced	35%	65%	
Algebra I: Proficient	94%	94%	
Office Referrals:	8th	9th	10th
first year	30	3	6
second year	20	10	10
Failure rate:			
first year	17	8	3
second year	101	14	12

A large urban school developed a model for student-based instruction. Students developed a self-paced instruction manual for the Gateway examinations. The population that utilized the manual met or exceeded the student population that utilized the state-developed instruction manual. In this project, the developers expanded their communication and presentation skills. Additionally, their academic performance improved due to the fact that they had to study the Gateway skills at an in-depth level. Another urban school developed a CTE career academy. One of the CTE program areas was losing students and few were concentrating in an area. The curriculum offerings were suffering as well as the entire program. After academy development, student interest increased. The Gateway predictor scores were used to compare student progress, and, in every case, the participating students performed well above the predictions. The model was used to develop other career academies within the school, which have shown similar success.

The CATI schools involved in the study: Original Sites: Oak Ridge High School, Rutledge High School, Blackman High School, Hampshire School, Adamsville High School, Centennial High School, Humboldt High School, Haywood High School, White County High School. Test Sites: Washburn School, Santa Fe School, McNairy Central High School, Milan High School, Smith County High School, Brighton High School, Lawrence County High School, Independence High School

High Schools That Work (A Southern Regional Education Board program):

The Southern Regional Education Board (SREB) produced a book, *Students Can't Wait: High Schools Must Turn Knowledge into Action* (Bottoms et al.) which states, "Getting more students to successfully complete a challenging academic curriculum requires schools to do more than enroll students in courses with the right titles. School and teacher leaders must accept responsibility to implement the following research-based school and classroom practices having to do with relevance and relationships:

- Raise expectations for students' work.
- Strengthen students' literacy knowledge and skills.
- Provide quality mathematics instruction.
- Provide quality science instruction.
- Provide quality career/technical education.
- Provide quality work-based learning.
- Involve parents in a guidance system to help students develop a high school program of study leading to further learning.
- Provide extra help to assist students in meeting high expectations.
- Create a school culture to help students understand the importance of high school. (p. 39)

The report *Students Can't Wait: High Schools Must Turn Knowledge into Action* compares characteristics of 75 high-performing schools in the High Schools That Work (HSTW) network with those of 75 other schools that have similar student demographics but made no gains in achievement from 2002 to 2004. To qualify as one of the 75 high performing schools, the schools in the network had to make statistically significant gains in at least two of three areas—reading, mathematics and science—between 2002 and 2004 on the HSTW assessments. In the schools all groups of students improved achievement—regardless of race, ethnicity or socioeconomic background. (p. 4)

More students at the most-improved schools had access to high-quality career/technical programs. The career/technical programs provided students opportunities to apply their academic skills to authentic, work-related assignments. The report suggests that "we may not be able to teach all students high-level academics unless we connect that learning to a context…that gives it meaning. Schools that are blending more rigorous academics with the applied learning of career/technical education are encouraging more students to stay in school."

"While the most-improved schools in this study provide more access to high-quality career/technical programs and higher-level academic courses, they do not stop there. *Teachers at these schools change how students are taught….*Teaching and learning strategies need to accommodate students who learn best through applied, career-oriented strategies.

All students need to master the skills, concepts and content associated with a rigorous high school curriculum—English, mathematics and science.

Not all students learn effectively with an academic or abstract approach to teaching the essential skills, concepts and content. More likely, a high proportion of students learn best through teaching and learning that leads with career-oriented, real-world applied contexts" (p.7).

Some of the CATI grant schools also participated in the High Schools That Work program. A school can benefit from coordinating the activities in which it is involved toward the overall growth of the school. Common needs might be identified and addressed in a school's improvement plan, its High Schools That Work activities, and its use of grant opportunities, such as the CATI grant. Less important than any one activity is a school's ability to work as a common team in a focused plan. The activity—any activity—is not the end, the goal is student achievement. Coordinated efforts toward achievement can appear in more than one forum.

For example, one of the CATI grant schools which was also a member of High Schools That Work found benefits in the data reported to High Schools That Work, as well as in the data assessing the effectiveness of the CATI grant study.

This school, which was a pilot site for a reading initiative as part of the CATI grant reported improvement in several relevant categories for those students who received the benefit of the combined programs.

Item	2004-05	2005-06
Improvement in the ACT reading score	20.9	21.2
Increase in the percentage of students taking the ACT	47%	48%
Decrease in the dropout rate	8%	7.7%
Increase in the percentage of graduates entering postsecondary studies	46%	48%
Increase in the number of students completing four credits in a planned career-technical sequence	103	116
Increase in the average reading or English score on the state assessment	41.38	44.92

Another school emphasizing academic and career/technical integration which participated in both the CATI grants and the High Schools That Work network used a senior research project to engage students in real-world application of content and problem solving. Among the students participating in both projects, the school reported an increase in the average mathematics score on the state assessment to 38.5 in 2005-06 from 36.15 in the previous school year, and an increase in the average reading or English score on the state assessment in 2005-06 to 42.47 from 40.4 in the previous year. The school also reported an increase in the attendance rate among these students to 93.9% in 2005-06 from 93.3% during the previous year.

All of the High Schools That Work (HSTW) sites in Tennessee focus on implementing ten key practices. Professional development is a primary focal point of the entire project. An emphasis of the program is the development of academies and small learning communities. Several school sites in Tennessee have developed 9th grade academies. Some of the academies are career focused and some have a career component but are not necessarily career focused.

High Schools That Work sites in Tennessee: Anderson County High School, Clinton High School, Campbell County High School, Rutledge High School, Oak Ridge High School, Washburn School, Grundy County High School, White County High School, Wilson Central High School, Lebanon High School, Fayette-Ware High School, Alvin C. York Institute, Haywood High School, Adamsville High School, McNairy Central High School, Halls High School, Ripley High School, Crockett County High School, Henry County High School, Fred J. Page High School, Blackman High School, Houston County High School, Eagleville High School, LaVergne High School.

Improving Student Performance through Academies and Small Learning Communities

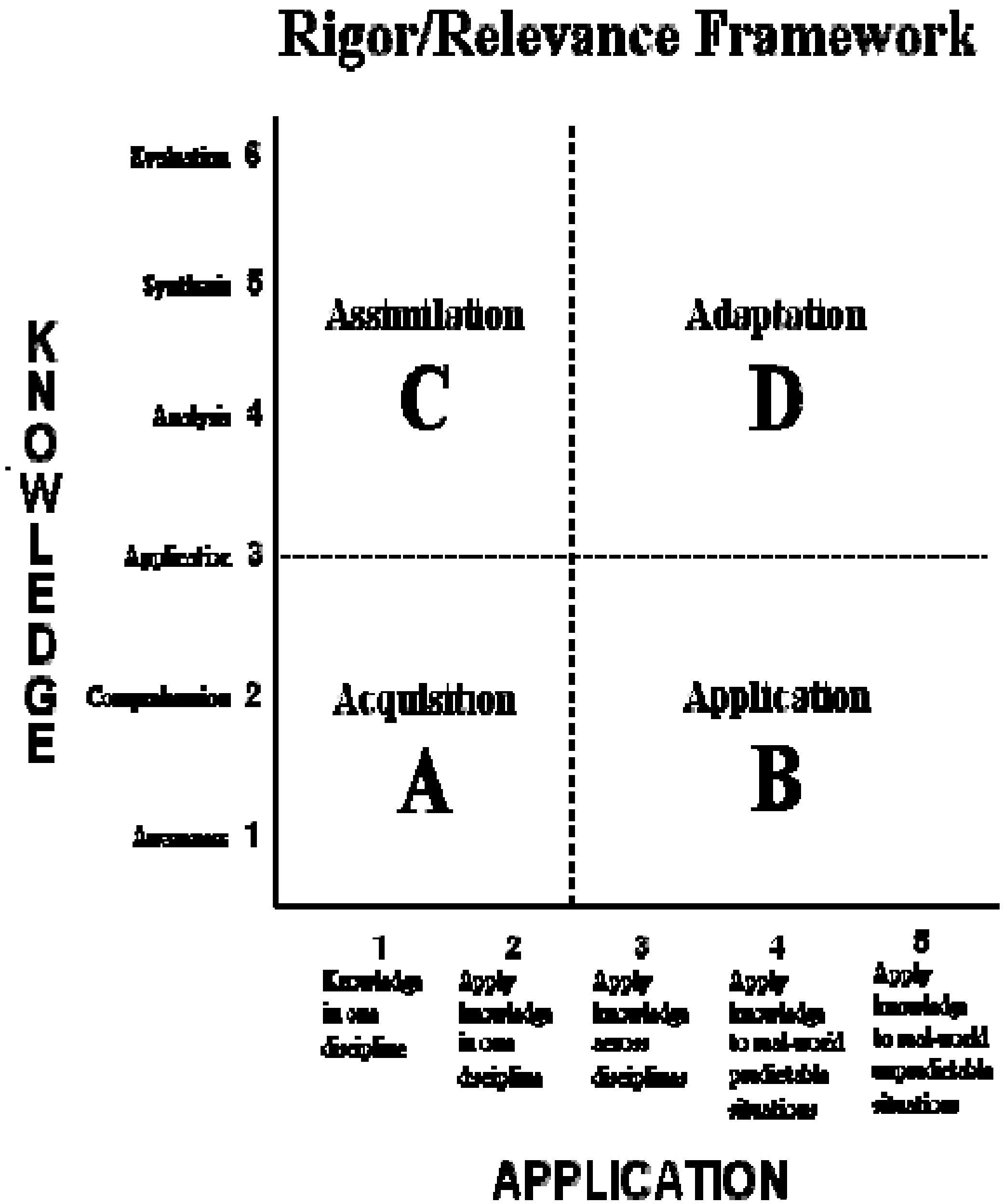
The primary purpose of an academy is to improve student achievement. The method is different from the traditional school schedule. In academies, students move through a schedule somewhat together as a group. Common academic instruction with a career emphasis is common. Many academies are career focused. Another closely related program is the small learning community concept. Many times these two terms are used interchangeably. However, in a small learning community, students stay together as a group in all classes throughout the day. According to SREB, academy and small learning community development involves the following:

1) Support rigorous academic standards and instructional methods that motivate and engage students;
2) Make meaningful connections between the abstract aspects of the curriculum and real-world learning experiences;
3) Create and manage a system of support that enables all students to meet high standards and motivates faculty to have high expectations of all students;
4) Set priorities for change that can be measured and managed realistically;
5) Create a personal, caring school environment that helps students meet higher standards;
6) Apply research knowledge to improve school practices.

High Schools in Tennessee with Academies (not all schools listed are HSTW sites): Campbell County High School, Oak Ridge High School, McNairy Central High School, Dyersburg High School, Henry County High School, Blackman High School, East Ridge High School, Red Bank High School, Centennial, Fairview High School, Ravenwood High School

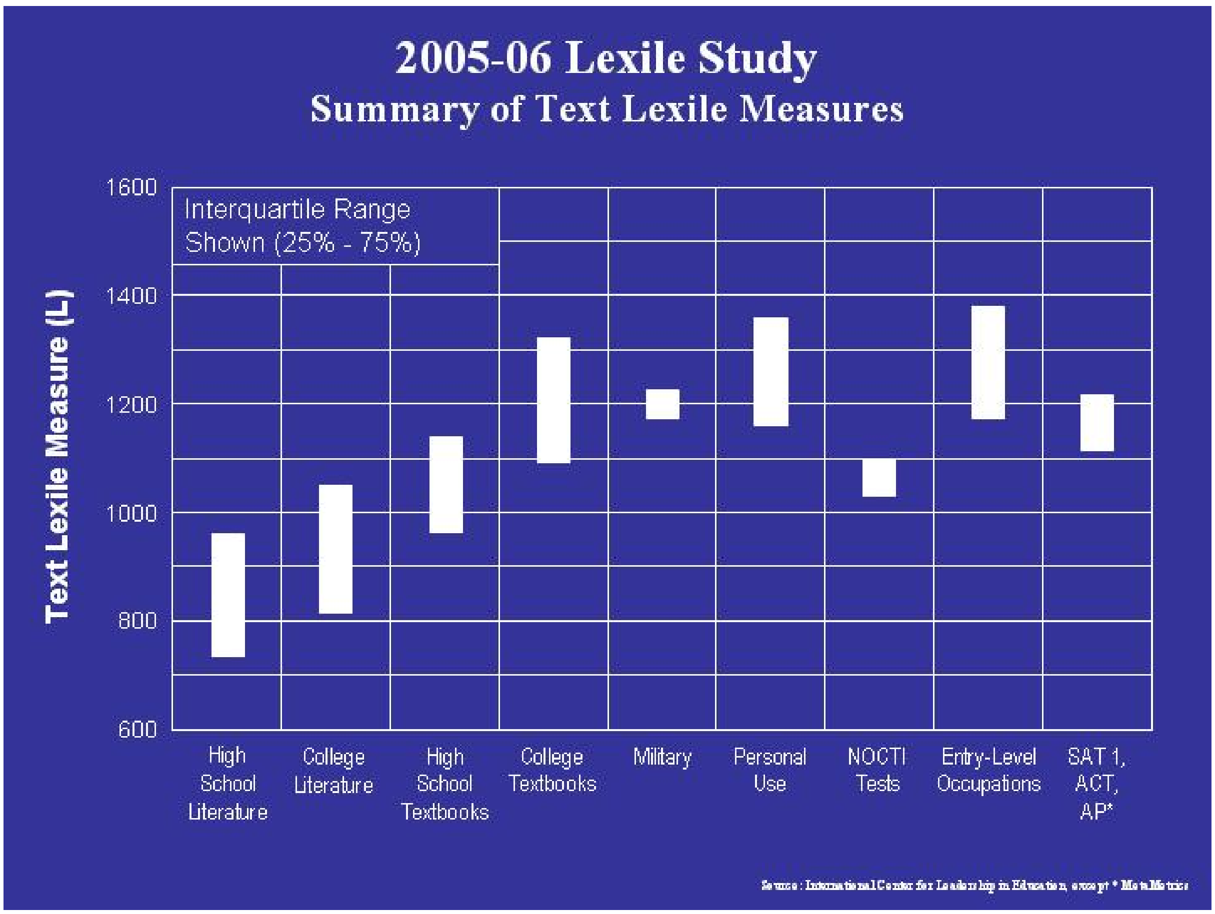
Emphasizing Curriculum Integration through a Rigor and Relevance Framework

Bill Daggett in the Rigor/Relevance Framework points to the important need for students and workers to apply at all levels knowdge to the real world in unpredictable situations. The Rigor/Relevance Framework is a tool developed by staff of the International Center for Leadership in Education to examine curriculum, instruction, and assessment. The Rigor/Relevance Framework is based on two dimensions of higher standards and student achievement.



Rigor/Relevance Framework™

In fact, the International Center for Leadership in Education reported that "a large number of entry-level jobs have higher reading requirements than are required for high school graduation. Reading in the following career cluster areas ranked at the 75th percentile for entry-level occupations if employees are to be successful on the job. The organization lists the following entry-level occupations calling for high reading levels: Law & Public Safety, Agriculture/Natural Resources, Education & Training, Transportation/Distribution/Logistics, Architecture/Construction, Manufacturing, Business & Administration, Health Science, Retail/Wholesale, Hospitality & Tourism, Scientific Research/Engineering, Human Services, and Arts/AV Technology/Communications.



The report notes that "entry-level jobs today often have higher reading requirements than many of the more advanced positions in the same field…. While white-collar workers may do more reading on the job, the material that many blue collar workers must read is both complex and extremely critical to job performance. Poor comprehension of technical manuals and installation instructions, for example, can have disastrous results." (Daggett, 2003)". The Rigor and Relevance chart (above) illustrates that, only in Quadrant D (Adaptation) will students be ready to face the challenges of a continuously evolving workplace with new problems appearing each day.

These conclusions were later reinforced by a 2006 study by the International Center which reported that reading requirements for entry-level jobs may be much higher than was ever expected. That study placed Finance, Public Safety/Secuirty, Information Technology, Health Science, Manufacturing, and Hosptality /Tourism at the top, but also noted the high reading level required for personal use in such documents as health and medical insurance forms and applications, newspapers, federal tax forms, and automobile warranties. That report said, “Perhaps even more surprising, entry-level job reading requirements exceed the reading requirements of all but the most technical college coursework.”

According to the report: “ The disconnect in reading expectations between school and the workplace indicates that many high school and college graduates will have difficulty performing effectively in the entry-level jobs into which they will be hired. Additionally, while our current high school graduation standards in English language arts may be daunting for many students, they appear to be not high enough to prepare students for beginning-level job requirements.” (Daggettt and Hasselbring, “What We Know About Adolescent Reading.” 2007).

Bottoms et al (2006) found in their study that all student groups improve when given similar experiences. They further state, “The test of any high school refrom movement is whether it advances the achievement of all students” (p. 5). Furthermore, some educators will say they know what to do but don’t have the people to do it. Bottoms contends, “Schools get remarkable performance from the teachers they have when conditions for teaching and learning are improved” (p. 4).

STEM in Technology Engineering Education

Tennessee has the benefit of a more cost-effective program than Project Lead the Way (PLTW) targeted toward technological literacy and pre-engineering through its Technology Engineering Education program. This middle and high school program is based on curricula of the International Technology Education Association, which also served as a foundation for the PLTW program.

In considering these activities, it may be helpful to explore briefly a definition of technological literacy. In the report, *Technically Speaking: Why All Americans Need to Know More About Technology* (2002), the International Technology Education Association (ITEA, Technology for All Americans Project) and the National Academy of Engineering define technological literacy as much broader than an ability to use artifacts of technology, such as, computers and software, aircraft, pesticides, and water-treatment plants. (p. 2).

The ITEA report provides examples of definitions of technological literacy which includes the following:

- Technology is the innovation, change, or modification of the natural environment in order to satisfy perceived human wants and needs (ITEA).

- The goal of science is to understand the natural world, and the goal of technology is to make modifications in the world to meet human needs. (National Science Education Standards, National Research Council, 1996, p. 24).
- In its broadest sense, technology is the process by which humans modify nature to meet their needs and wants. (Technically Speaking, p. 1, National Academy of Engineering).

The following are examples of Technology Engineering Education (ITEA-based) professional development activities and assignments teachers receive as a part of the program. Additionally examples for student instruction and participation are included.

At the 2008 State Professional Development Conference, high school teachers will be asked to assume that they have been requested by the Yankees' stadium owner to build a geodome roof for the baseball stadium. Specifications for the dome include the allowance of a given amount of natural light, as well as expansion capability, with features that are flexible to the needs on rainy and dry days. Additionally, they will be asked to develop a cost analysis of this project. Teachers will use a problem-solving systems approach known as I^3 (Invention, Innovation, and Inquiry). The report *Rising Above the Storm* recommendations include inquiry-based learning. For example, in using their mathematical and scientific knowledge and skills, they will need to ensure for such aspects as the structural integrity of the walls.

A professional development activity for middle grades teachers will call for teachers to design a simple portable home for a homeless family of four that can be manufactured for less than $500. The criteria would require teachers to incorporate in the design the calculation of the body temperature of four people and they will need to consider the strength and viability of materials and fabrics used in the project.

Students are given similar problem-solving activities as a part of their instructional program. For example, a team of two middle school students will identify and research a specific environmental problem or issue that has been influenced by advancements in technology. They will be asked to gather information, analyze data, develop strategies and submit conclusions relative to the specific problem or issue and report their findings in a multimedia presentation.

High school students will work in a team, comprised of three students, to solve a design problem, such as a need for a wheelchair with better mobility. They will incorporate scientific and mathematical principles and concepts as they develop a solution to the problem.

Schools with Technology Engineering Education programs include the following: Farragut High School and Karns Middle School (Knox Co.), Chattanooga Middle Museum Magnet School and Hunter Middle School (Hamilton Co.), Fred. J. Page High School (Williamson Co.), East High School (Memphis City)

Resources

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